



DEPTHS: Field-based summer school on subduction forearc dynamics

Subduction zones are of primary importance for understanding the interactions between the Earth's surface and the deep levels of the planet and assessing the potential implications for the climate. The international Summer School "DEPTHS" aims to analyze the dynamics of subduction forearcs through a highly multidisciplinary approach, with particular emphasis on exhumation processes and the deep carbon cycle. The course is aimed primarily at PhD students in the various fields of Earth Sciences. It includes one day of classroom lectures in Milan and four days of field lessons based on geological observations along key transects across the Western Alps, one of the best-studied fossil subduction zones on Earth. Lectures will integrate petrological, tectonic, and stratigraphic evidence along the analyzed transects with the results of recent geophysical experiments on the deep tectonic structure of the Alps. Lectures will be held by geologists, petrologists, and seismologists from University of Milano-Bicocca, ISTERre Grenoble, and University of Torino, who will interact all together with the students both in the classroom and in the field while hiking and discussing in front of intellectually stimulating outcrops in the breathtaking alpine landscape. The DEPTHS Summer School is funded by DISAT within the framework of the Departments of Excellence Project.

SCIENTIFIC COMMITTEE:

Marco G. Malusà (University of Milano-Bicocca)

Simona Ferrando (University of Torino)

Stéphane Guillot (ISTERre Grenoble)

Chiara Groppo (University of Torino)

Anne Paul (ISTERre Grenoble)



Under the patronage of: In collaboration with:



Parco del Monviso

PERIOD: from Monday 6 September to Friday 10 September 2021

PLACE AND TEACHING METHOD:

- 6 September: Classroom lectures at the University of Milano-Bicocca, Milan, Italy
- 7-10 September: Lessons in the field in various locations in the Italian Western Alps (Aosta, Varaita, Po and Bormida valleys).

ECTS: 3 (8 hours of classroom lectures, 20 hours of activity in the field)

NUMBER OF PARTICIPANTS: Twenty places are available, five of which are reserved for PhD students from the University of Milano-Bicocca. Priority will be given to PhD students. In case of availability, participation will also be open to early career scientists. Candidates will be selected based on the relevance of their doctoral project with the contents and multidisciplinary nature of the course, also considering the need to ensure equal representation of gender and nationality.

REGISTRATION FEE: The registration fee for non-UniMiB students is 100 euros, and includes travel, board, and lodging expenses for the entire duration of the course, from the morning of 6 September to the afternoon of 10 September. The registration fee does not include transport costs to reach Milan, health insurance for non-EU participants, any addendum in the hotel.

REQUESTED DOCUMENTS TO BE UPLOADED IN THE APPLICATION FORM:

CV, ID card or passport, motivation letter



THE LECTURERS:



Marco G. Malusà is a geologist at the University of Milano-Bicocca whose main research emphasis is the tectonic evolution and exhumation processes of orogenic belts and associated detrital fluxes to sedimentary basins. His research integrates thermochronology with field geology (sedimentology, stratigraphy, structural geology) and geophysics in orogenic belts and sedimentary basins from the Mediterranean to the Pacific. He took part to the CIFALPS and CIFALPS2 seismic experiments across the Western Alps.



Simona Ferrando is a petrologist at the University of Torino. Her research activities mainly focus on metamorphic petrology and fluid-rock interactions and on the application of Raman spectroscopy to Earth Sciences. Study areas include extensional and compressional tectonic settings such as the Western Alps, Sulu, Himalaya, Greenland, and the Ethiopian plateau.



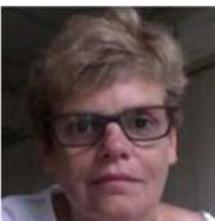
Maria Luce Frezzotti is a petrologist at the University of Milano-Bicocca whose main research emphasis is the origin of fluids in the Earth's interior and the deep carbon cycle. She has published on the fluid phases involved in most petrological and geochemical processes, on recycling of volatiles by mantle melting, and volcanism (e.g., CO₂ recycling), and on the variations in the chemical composition of the lithosphere through time.



Stéphane Guillot is a geologist at ISTERre Grenoble and specialist in convergence zones; he worked primarily on the Himalayan-Tibet and Alpine orogenic systems but also explored the Caribbean, West Africa, Antarctica and South America as well as the European Variscan Range. His approach is deliberately multidisciplinary, working regularly with geochronologists, geochemists, and geophysicists. He took part to the CIFALPS and CIFALPS2 seismic experiments and is presently Deputy Scientific Director of INSU-CNRS in charge of the Solid Earth field.



Chiara Groppo is a petrologist at the University of Torino. She applies phase petrology modelling to investigate the P-T evolution of metamorphic terranes and to clarify the processes of carbon production, transfer, fixation and outgassing in non-volcanic, tectonically active areas. Study areas include the Western Alps, Himalaya, and Karakorum.



Anne Paul is a structural seismologist at ISTERre Grenoble. Her main research interest is the geodynamics of the continental lithosphere in regions of active continental collision (Alps, Anatolia, Zagros, Pyrenees, Andes, Tibet). Her main tool is seismic tomography from data of temporary seismic arrays. She is co-PI of the CIFALPS and CIFALPS2 seismic experiments across the Western Alps.

LOGISTICS: Transport by bus/minibus during the four days of field work. Dinner and overnight in hotels or mountain huts located in villages and small towns in the Western Alps. Field lessons will take place in a mountain environment at altitudes ranging from a few hundred meters to about 2500 meters above sea level (appropriate equipment required: hiking boots, warm clothes, waterproof jacket, mountain backpack).

courtesy Parco del Monviso



COVID-19 RESTRICTIONS: All the activities will be held in accordance with the Covid-19 pandemic containment measures and requirements in force on the Italian territory. Pending the updated provisions regarding the social distancing and use of the mask, it is expected that a negative swab (molecular swab taken within 48 hours previously) or vaccination document may be required for participation in the course (more detailed provisions will be provided in subsequent circulars considering the new regulatory updates). Non-EU participants must have health insurance for the entire duration of the course and must inquire about any restrictions on access to Italy.

FOR FURTHER INFORMATION, CONTACT: marco.malusa@unimib.it

DETAILED PLAN

Monday 6 September (Milan, Piazza della Scienza, University of Milano-Bicocca, Room U2-07)

h 8:30-9:00 *Registration*

h 9:00-9:15 *Welcome and opening of the course by the Director of the Department and the President of the Doctoral School*

h 9:15-9:30 *Presentation of the lecturers and the program of the Summer School*

h 9:30-10:00 *Short presentation of the participants (1 minute and a half + 1 slide each)*

h 10:00-10:45 **Lecture 1 (Marco G. Malusà):**

The Alpine fossil subduction zone and the geological records of exhumation

h 10:45-11:00 *Questions/Discussion*

h 11:00-11:30 *Coffee Break (on site)*

h 11:30-12:15 **Lecture 2 (Simona Ferrando & Maria Luce Frezzotti):**

Metamorphic petrology and carbon evolution in the subduction forearc

h 12:15-12:30 *Questions/Discussion*

h 12:30-13:30 *Lunch Break (on site)*

h 13:30-14:15 **Lecture 3 (Stéphane Guillot): The role of serpentinites**

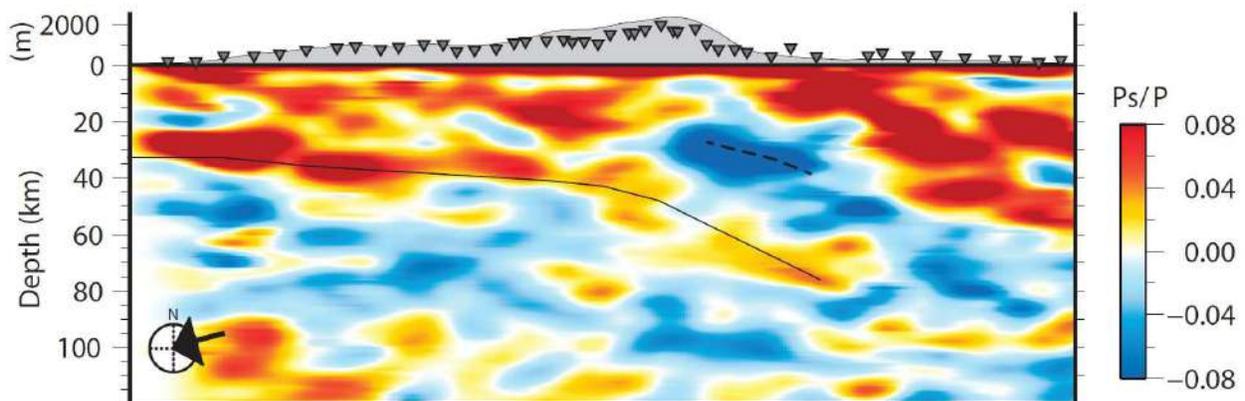
h 14:15-14:30 *Questions/Discussion*

h 14:30-15:15 **Lecture 4 (Anne Paul & Marco G. Malusà):**

The deep structure revealed by geophysical experiments

h 15:15-15:30 *Questions/Discussion*

h 15:30 *Transfer by bus to upper Aosta Valley, evening lecture, dinner, and overnight stay*



Tuesday 7 September: A transect along the CIFALPS2 profile: the lower plate and tectonic relationships within the subduction wedge

h 8:30-10:30 *Mont-Blanc Massif and Frontal Pennine Fault*

h 11:00-13:00 *The frontal greenschist- and blueschist-facies units of the subduction wedge*

h 14:00-17:30 *The Gran Paradiso eclogitic dome and its metaophiolitic envelope*

h 17:30 Transfer by bus to lower Aosta Valley, evening lecture, dinner, and overnight stay

Wednesday 8 September: The upper plate and the Dora-Maira Unit along the CIFALPS profile

h 8:30-11:00 *Sesia-Lanzo unit and the Cretaceous wedge*

h 11:00-12:00 *The upper-plate lower crust*

h 12:30-14:30 Transfer by bus to lower Varaita Valley

h 14:30-18:00 *The Dora-Maira eclogitic dome*

h 18:00 Transfer by bus to upper Po Valley, evening lecture, dinner, and overnight stay

Thursday 9 September: The Viso metaophiolites along the CIFALPS profile

h 8:00 Transfer by minibus to Pian del Re - upper Po Valley

h 9:30-15:00 *A journey across the Viso metaophiolites*

h 15:00 Transfer by bus to Bormida Valley, evening lecture, dinner, and overnight stay

Friday 10 September: Sediments atop the eclogitic dome: Voltri-Valosio and the overlying Tertiary Piedmont Basin succession along the CIFALPS 2 profile

h 8:30-10:00 *Valosio unit*

h 10:00-12:00 *Molare Fm and overview of the Voltri Unit*

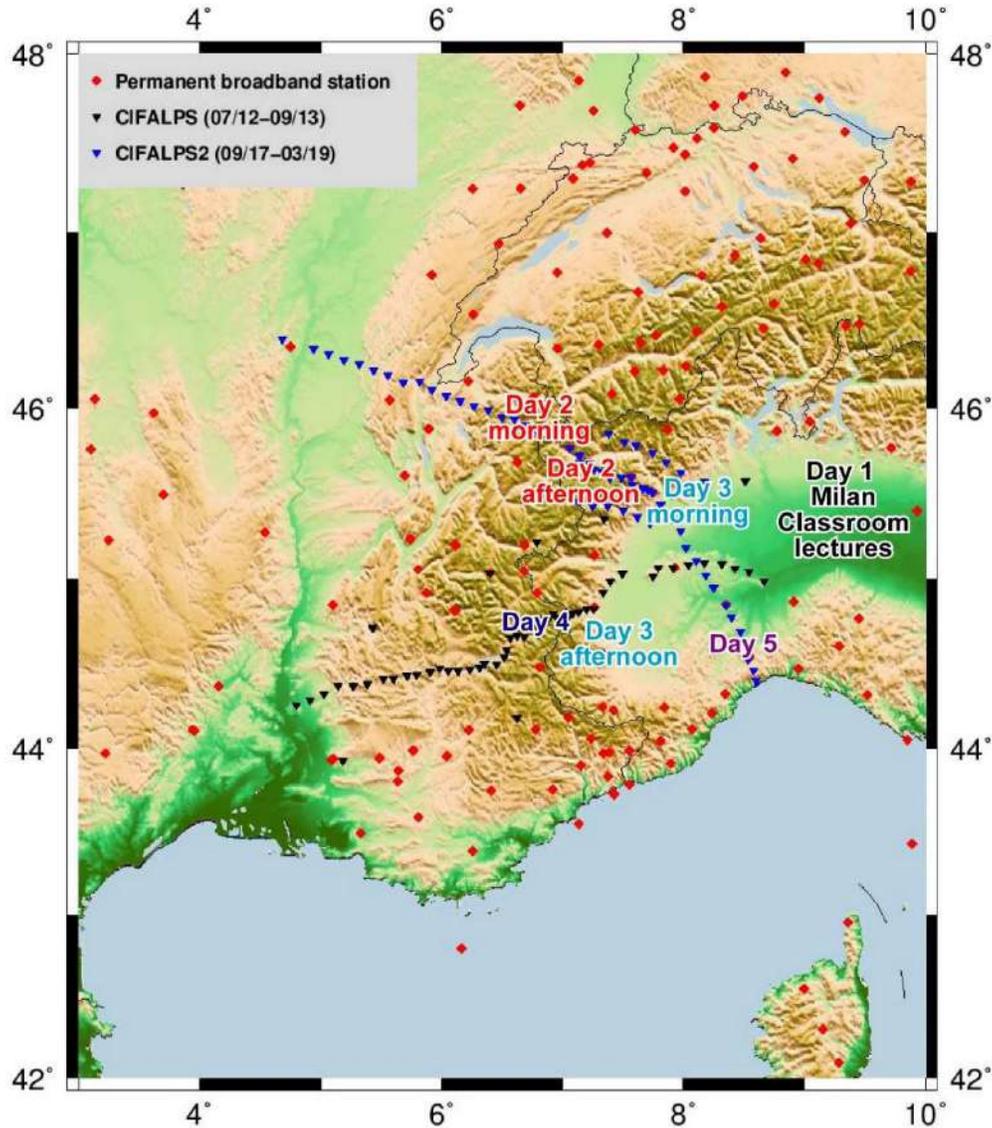
h 12:30-13:30 *The Oligocene sedimentary succession*

h 13:30-14:30 *The Voltri peridotite*

h 14:30-16:00 *Oligocene fossil corals on the Voltri Unit*

h 16:00 Return by bus to Milano Centrale railway station (expected arrival at 18:30)





SUGGESTED PRELIMINARY READINGS:

Malusà et al (2015) Contrasting styles of (U) HP rock exhumation along the Cenozoic Adria-Europe plate boundary (Western Alps, Calabria, Corsica). *Geochemistry, Geophysics, Geosystems* 16(6), 1786-1824. <https://doi.org/10.1002/2015GC005767>

Malusà et al. (2021) The Deep Structure of the Alps Based on the CIFALPS Seismic Experiment: A Synthesis. *Geochemistry, Geophysics, Geosystems*, 22(3), 1-42, e2020GC009466, <https://doi.org/10.1029/2020GC009466>